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RELATIONSHIP BETWEEN THE RADIOEMISSION FLUX FROM LOCAL SOURCES AND THE STRUCTURE OF ACTIVE REGIONS OF THE SUN OBSERVED OPTICALLY

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SUMMARY

This paper presents a statistical analysis of solar data for 1961 and 1963 in an attempt to broaden the possibilities of interpretation of the relationship between radioemission from local sources and the structure of the active regions of the Sun observable optically.

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The radioemission characteristics of local sources on the Sun, required for the investigation of solar activity, are insufficiently studied; at the same time a series of anomalous cases, difficult to explain, are known. In order to obtain more complete data allowing to broaden the possibilities of interpretation of the observations avaialable, we bring forth below the results of statistical processing of daily radioastronomical observations available at the Moscow Center on Data Collection.

We subjected to analysis the observations for 1961 and 1963, sorted according to criteria referred to in [1, 2]. Moreover, we rejected the cases linked with the emergence of sources on the E-limb and their vanishing in the West limb of the Sun with two-day reserve. Then we composed equations of the form

$$F_{\lambda_i} = \alpha_{1\lambda_i} \sum_{k=1}^{n} S_{r\pi_k} + \alpha_{2\lambda_i} \sum_{k=1}^{n} (S_{p_k} - S_{r\pi_k}) + \alpha_{3\lambda_i} \sum_{j=1}^{m} S_{\Phi_j} + F_{0\lambda_i},$$

where F_{λ_i} is the total radioemission flux on wavelength λ_i; $S_{r\pi_k}$ is the area of the principal spot of the k-th group in millionth fractions of Sun's hemisphere; $\alpha_{1\lambda_i}$ is the proportionality factor linked with the main spot; n, m is the number of groups of spots and flocculi on the disk of the Sun for the given day. S_{p_k} is the total area of the k-th group of spots in millionth fractions of Sun's hemisphere; $\alpha_{2\lambda i}$ is the proportionality factor linked with

* O SVYAZI POTOKA RADIOIZLUCHENIYA LOKAL NYKH ISTOCHNIKOV NA SOLNTSE SO STROYENIYEM AKTIVNYKH OBLASTEY NABLYUDAYEMYKH OPTICHESKI.

the remaining spot groups; S_{Φ_j} is the area of the j-th flocculus in ppm fractions of Sun's hemisphere; $\alpha_{3\lambda}$ is the proportionality factor linked with the area of flocculi; $F_{0\lambda_i}$ is the radioemission flux of the quiet Sun.

$\alpha_{1\lambda_i}$, $\alpha_{2\lambda_i}$, $\alpha_{3\lambda_i}$ and $F_{0\lambda_i}$ were found by the method of least squares the radioastronomical observations of the station Toyokawa, and the optical data published in the bulletin "Solar Data". All calculations were performed in the computing center of the Lenin State University in the name of Zhdanov by means of an M-20 computer.

The results of calculations are compiled in Table 1 hereafter.

TABLE 1

λ, см	$\alpha_{1\lambda_i}\cdot 10^3$	$\alpha_{2\lambda_i}\cdot 10^3$	$\alpha_{3\lambda_i}\cdot 10^6$	$F_{0\lambda_i}\cdot 10^{22}$, w/m^2·hz
		1961 г.		
3,2	24 ± 3	11 ± 2	35	244
8,0	23 ± 2	28 ± 3	63	89
		1963 г.		
3,2	26 ± 3	13 ± 2	30	236
8,0	24 ± 2	27 ± 2	50	81

It follows from Table 1 that the ratio of radioemission intensity of two regions of the source, i. e. the groups of spots linked with the main spot and the remaining spots of the group, depends on λ: at λ = 8.0 cm these intensities coincide within the measurement errors, whereas at λ =3.2 cm their ratio is of the order of 2. This leads to a noticeable difference of the contribution to the general radiation of the main spot's region and the remaining part of the group.

The noted peculiarity may be caused by different contribution of bremmstrahlung and magnetic bremmstrahlung mechanisms to the radiation of the different regions of the source, for the intensities of the magnetic field H of the main and peripheral points are different (H increases as the spot area increases). The magnitude of the intensity sufficient for the effectiveness of the magnetic bremmstrahlung mechanism, depends on λ(it decreases with the rise of λ) and this is why at λ = 8 cm this mechanism is effective for all the spots of the group, and at λ = 3.2 cm, it is effective only for the main spot.

The results brought out agree well with the observations of solitary sources and allow us to diminish the disparity of the data in various publications. For example, spectra of 10 sources are brought out in [3], including two anomalous ones: in them the radioemission flux at λ = 3.2 cm was found to be greater than that at λ = 8 cm. The calculation of the ratio $S_{гл}/S_{р}$, provided for them the values 0.92 and 0.87, as distinct from the same magnitude for the remaining ones, fluctuating between 0.65 and 0.14, as should have been expected from the above results.

The results of observations of 60 separate sources at λ = 3.2 cm and λ = 7.5 cm are presented in [4]. The utilization of these data for the construction of the relationship between $F_{3,2}$ / $F_{7,5}$ and gives the dependence

the dependence plotted in Fig.1, also agreeing well with the above conclusions.

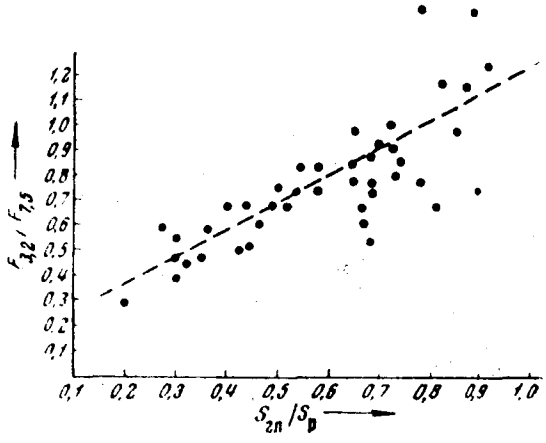

Fig.1

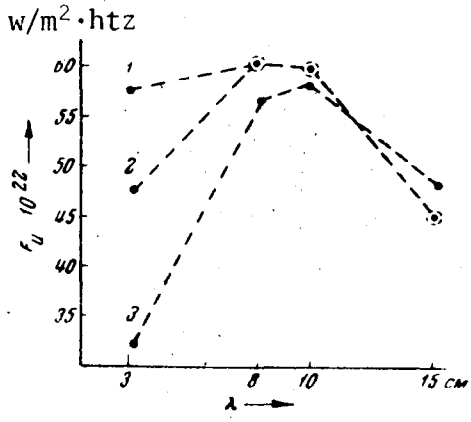

Fig.2

Several spectra of solitary sources with identical S_p, but different could be constructed by the results of measurements of stations Toyokawa and Ottawa. As follows from Fig.2 (1°. $S_{rп}/S_p$ = 0.92; 2° it is 0.50 and 3°. it is 0.30), the above dependences of the shape of the spectrum on the ratio $S_{rп}/S_p$ are fulfilled. A stronger dependence of the flux on the magnetic field at λ = 3.2 cm than at λ = 8 cm must be reflected in the dimensions of the source, which is confirmed by observations during eclipses, according to which at λ = 3.2 the attraction of the source is lesser than at λ = 10 cm [5]. Besides, it follows from the above that at observations with sufficient angular resolution the source above a complex group of spots must consist, at least at some wavelengths, of two parts. Such cases are described in literature [5].

The above strong dependence of $F_{3,2}/F_{7,5}$ on $S_{rп}/S_p$ could be compared with the relationships of the ratio $F_{3,2}/F_{7,5}$ with the probability of occurrence of a proton burst indicated in [4]. We expect that one may succeed in forecasting such a burst from optical observations determining the ratio $S_{rп}/S_p$. Preliminary checking of 18 bursts provided a corroboration of such an assumption in 14 cases.

***** T H E E N D *****

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